Unit 6: Ch. 13, 14, 15

Quiz → R 4/24

Quiz → W 4/30

Test → F 5/2

## Ch. 13:

- Random phenomena → things that happen with no set pattern
- Law of Large Numbers → as the number of independent trials increases, the long-run relative frequency of repeated events gets closer and closer to some number

independent → outcome of one trial does not affect the outcomes of others

- Probability → relative frequence determined by the LLN
- Nonexistent Law of Averages
  - LLN says nothing about short-term behavior
  - Sequences of random events don't compensate in the short run and don't need to do so to get back to the long-term probability

- Theoretical Probability:
  - Mathematical models to figure out probabilities
  - Trial → each time we observe random phonemena
  - Outcome → result of a trial
  - Sample Space → set of all possible outcomes
  - Equally Likely Condition → outcomes being counted are all equally likely to occur
  - $$P(A) = \frac{\#\text{ outcomes in } A}{\#\text{ possible equally likely outcomes}}$$

    ↳ Probability of A
  - Example → 5's in a deck of cards

    4 → 5's

    52 → total cards

    $$P(5) = \frac{4}{52} = \frac{1}{13}$$

Suppose a family has two children. In order of birth, they may be a boy and a boy, a boy and then a girl, a girl and then a boy, or a girl and then a girl. Let's represent those outcomes as the sample space S = {BB, BG, GB, GG}.

a) What are we assuming in thinking that these four outcomes are "equally likely"?

b) What's the probability a 2-child family has two girls?

c) What's the probability there is at least 1 girl?

d) What's the probability that both children are the same sex?

a) Outcome of being a boy or girl is random and independent.

b) $P(2 \text{ girls}) = \frac{1}{4}$

c) $P(1 \text{ girl}) = \frac{3}{4}$

d) $P(\text{same gender}) = \frac{2}{4} = \frac{1}{2}$

Now let's think about families with three children.

a) Create a sample space of equally likely outcomes.

b) What's the probability that a 3-child family has at least one girl?

c) What's the probability that there are both boys and girls in the family?

a) $S = \{ BBB, GGG, BBG, GBG, BGB, GGB, BGG, GBB \}$

b) $P(1 \text{ girl}) = \frac{7}{8}$

c) $P(B \text{ and } G) = \frac{6}{8} = \frac{3}{4}$

- Fundamental Counting Principle:
  - OR
    - Or means add
    - If event A has m outcomes and event B has n outcomes, then the number of outcomes in event A or B is $m+n$.
  - AND
    - and means multiply
    - If event A has m outcomes and independent event B has n outcomes, then the number of outcomes in A and B is $m \cdot n$.